

REMARKS

Applicants and the undersigned are most grateful for the time and attention accorded this application by the Examiner. In the Office Action dated July 16, 2008, claims 1, 4-7, 10-14, 17 and 18 were pending. Claims 1, 7 and 13 are independent; the remaining claims are dependent. Claims 1, 4-7, 10-14, 17 and 18 stand rejected. In response Applicants have filed this Amendment wherein the independent claims have been rewritten and dependent claims 6 and 12 have been cancelled. The Office is respectfully requested to reconsider the rejections applied against the instant application in light of the foregoing amendments and the remarks presented below.

It should be noted that Applicants have amended and cancelled certain claims from further consideration in this application. Applicants are not conceding in this application that those claims are not patentable over the art cited by the Examiner, as the present claim amendments and cancellations are only for facilitating expeditious prosecution of the instant application. Applicants respectfully reserve the right to pursue these and other claims in one or more continuations and/or divisional patent applications.

Rejections under 35 USC 101

Claims 1, 4-7, 10-14 and 17-18 stand rejected under 35 USC 101 because the claimed invention is directed to non-statutory subject matter. Applicants respectfully disagree and request reconsideration and withdrawal of these rejections.

Applicants briefly note that the invention is useful in a real world context at least inasmuch as it provides for enhanced classification (e.g. of patterns such as those found

in speech data). The invention essentially operates by taking complex data of high dimensionality and reduces its dimensionality (i.e. simplifies it via transformation) while maintaining the essential and useful data characteristics needed for classification. The result is more accurate classification.

The claims were previously directed to statutory subject matter (i.e. an apparatus, a process, and a program storage device) which enabled for pattern recognition (i.e. a real world result, e.g. speech recognition). Nonetheless, in order to clarify that the claims are directed to statutory subject matter, Applicants have rewritten the independent claims. The claims, *inter alia*, now require that the input pattern be an “input speech pattern”; that the apparatus utilize a processor for transforming the input speech pattern into features to be utilized by the classifier; and that the claimed invention output a final classification result.

Therefore, Applicants respectfully submit that the claims are now more clearly directed towards statutory subject matter. Applicants respectfully request reconsideration and withdrawal of these rejections under 35 USC 101. Should the Examiner find that there are still issues with these claims regarding 35 USC 101, Applicants respectfully request that the Examiner contact the undersigned at the telephone number listed below.

Rejections under 35 USC 112

Claims 1, 4-7, 10-14, 17 and 18 stand rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement. The Examiner asserts that the claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the

time the application was filed, had possession of the claimed invention. Applicants respectfully request reconsideration and withdrawal of these rejections.

Regarding claims 1, 7 and 13, the limitation “wherein the optimizing is carried out in an unconstrained manner over all possible matrices” does not introduce new subject matter. The Examiner provides no other explanation for his conclusion save that “because the limitation is not specifically described in the original specification”. *Office Action*, pp. 6. As previously explained and as can be seen by the portion of the original specification regarding the objective function (pp. 7-14), the mathematics underlying the instantly claimed invention clearly indicate that it is inherent that all dimensions be optimized in an unconstrained manner. Had there been constraints place upon the optimization, they would certainly appear in the specification, such as they appear in the references of record (e.g. Decell, pp. 3B-6, stating with regard to Theorem 1 that “it suffices to consider *only those matrices* B belonging to the set...”). The unconstrained nature of the procedure is exemplified on page 15 of the specification where it is stated that a 39x216 matrix was computed through gradient decent *without any particular structure or constraint* (i.e. not limiting to a particular subset).

Nonetheless, in an effort to facilitate expeditious prosecution, Applicants have amended the independent claims to strike a portion of the language in question (i.e. the “unconstrained” language). Applicants maintain that the claims did (and continue to) find support in the specification as originally filed because the claimed features are inherently disclosed by the mathematics underlying the objective function optimization process and the example provided by the specification. Applicants are merely giving

expression to the workings of the equations utilized in the instantly claimed invention, and are hopeful that the amended claim language will be sufficiently clear. Therefore, Applicants respectfully request reconsideration and withdrawal of these rejections under 35 USC 112.

Claims 1, 4-7, 10-14 and 17-18 stand rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicants respectfully request reconsideration and withdrawal of this rejection.

The Examiner objects to the limitation “wherein the objective function is initialized with an LDA matrix” as being in conflict with another claim limitation (“wherein the optimizing is carried out in an unconstrained manner over all possible matrices”). Briefly, the equations of the instant specification make clear that the invention *initializes* the optimization of the objective function with the LDA matrix (see Specification, pp. 15, lines 15-16 wherein it states “[b]oth optimizations were initialized with the LDA matrix and carried out using...”). Though the optimization is *initialized* with the LDA matrix, it does not constrain the process as it proceeds through optimization (i.e. it serves as a starting point) and thus there is not conflict between these claim limitations. The Examiner is encouraged to contact the Applicant if confusion surrounding these concepts continues. Without further addressing the merits of this point, Applicants respectfully submit that this point has been rendered moot as Applicants have undertaken to rewrite the claims and in their amended form, no such purported conflict exists.

The Examiner further objects to claim 18 as being indefinite because, although all the variables have a common meaning understood by those of ordinary skill in the art, the variables in the claim itself are still indefinite. Applicants respectfully disagree with the Examiner's position. Because the equation of claim 18 has a clear meaning understood by those of ordinary skill in the art, and is fully devolved in the specification, it is not indefinite for lack of explicit definition of variables in the claim itself. Therefore, Applicants respectfully request reconsideration and withdrawal of this rejection.

Thus, Applicants respectfully request reconsideration and withdrawal of these rejections under 35 USC 112. To the extent that the Examiner, after taking up and considering this Amendment, determines that there are still outstanding issues as regards compliance with the requirements of 35 USC 112, *Applicants respectfully request that the Examiner contact the undersigned at the telephone number listed below.*

Rejections under 35 USC 103

Claims 1, 4-7, 10-14 and 17-18 stand rejected under 35 USC 103(a) as being unpatentable over Watanabe et al. (US 5,754,681) (hereinafter "Watanabe") in view of Decell et al., *An iterative approach to the feature selection problem*, Machine Processing of Remote Sensing Data, 1972 (hereinafter "Decell"). Applicants respectfully request reconsideration and withdrawal of the rejections under 35 USC 103(a).

As previously explained, *Watanabe is irrelevant to the instantly claimed invention in as much as Watanabe teaches a design for a multitude of feature spaces, one for each class. This stands in stark contrast to the instantly claimed invention, wherein only one*

(common) feature space is designed for all classes. *Specification*, Figure 2 and accompanying text (particularly item 134).

Moreover, nowhere does Watanabe teach or suggest that the optimization be initialized with the LDA matrix, as the claims explicitly require. Thus, Applicants respectfully submit that Watanabe is insufficient to teach the limitations of the claimed invention.

Similarly, a difference with Decell is that in the instantly claimed invention, the initialization of the optimization of the objective function *is with the LDA matrix* (*Specification*, pp. 16, lines 15-16) whereas Decell initializes it with something else entirely (i.e. an initial “B” such that $B \cdot B^T = I$ and $b^2_{ij} = b_{ij}$ see page 3B-9). Thus, *inter alia*, the cited references fail to teach that the objective function is initialized with the LDA matrix, as claimed.

It should be noted as well that Decell argues that the optimization should be carried out only on a particular subset of matrices, stating “it suffices to consider only those matrices B belonging to the set $B = [B \mid B B^T = I_k]$.” *Decell*, pp. 3B-6 (this is explained in the proof of Theorem 1). Decell parameterizes the matrices in a certain form and states that it is enough (i.e. constrained to these).

In contrast, the instantly claimed invention’s optimization is carried out in an unconstrained manner, i.e. *over all possible matrices*. This is explained on page 15 of the specification where it states that in trials there was found a 39x216 matrix through gradient descent *without any particular structure or constraint* and this is explicitly

recited in the claims. The fact that the Applicants did not impose any restraints (as are imposed in Decell) demonstrates the unconstrained nature of the procedure.

Furthermore, in order to expedite prosecution, applicants have amended the independent claims in an effort to more clearly distinguish the instantly claimed invention from that of art of record. Claim 1 now recites, *inter alia*,

inputting a *speech* pattern; *providing minimum Bayes error feature selection via* transforming the input pattern to provide a set of *features* for a classifier which classifies into classes, wherein there is only one feature space transformation for all classes; *and providing final features to the classifier, wherein the classifier provides a final output classification result*; said transforming step comprising the step of *directly* minimizing the probability of subsequent misclassification *in a projected space* of at least one feature; said *direct* minimizing step comprising: *performing a full-covariance gaussian clustering of input records for every class*; developing an objective function *by way of means, covariances and priors*, wherein said objective function *either*: maximizes an average pairwise divergence *and relates it to the Bayes error*; or *directly minimizes an upper bound on Bayes error*; optimizing the objective function through gradient decent, wherein all dimensions of a matrix are optimized via optimizing the objective function; wherein the optimizing is carried out over all possible matrices; and wherein the objective function is initialized with an LDA matrix; *upon convergence of the optimization, transforming all the records into $y = \theta x$ to produce the at least one final feature*; wherein said pattern recognition is speech recognition.

Claim 1 (emphasis added). These amendments are supported throughout the original specification and particularly at pp. 15-17 and figures 1 and 2. These claim amendments make clear that, in contrast to either Watanabe or Decell, the instantly claimed invention is capable of performing discriminant feature space projections by directly minimizing the probability of misclassification in the projected space by either: maximizing the interclass divergence and relating it to the Bayes error; or, by directly minimizing an upper bound on the Bayes/classification error. *Specification*, pp. 17. The optimization is

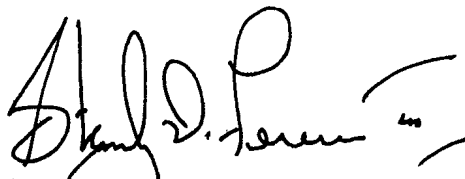
initialized with the LDA matrix, in contrast to either Watanabe or Decell. Either process leads to defining a smooth objective function which have as argument projection matrices and which can be numerically optimized. *Id.*

Conclusion

In view of the foregoing, it is respectfully submitted that independent Claims 1, 7 and 13 fully distinguish over the applied art and are thus allowable. By virtue of dependence from what are believed to be allowable independent Claims 1, 7 and 13, it is respectfully submitted that Claims 4, 5, 8-11, 14, 17 and 18 are also allowable.

In summary, it is respectfully submitted that the instant application, including Claims 1, 4, 5, 7, 10, 11, 13, 14, 17 and 18, is in condition for allowance. Notice to the effect is hereby earnestly solicited. **If there are any further issues in this application, the courtesy of a telephone interview is requested prior to the issuance of a further Office Action in this case.**

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Stanley D. Ference III", with a horizontal line underneath.

Stanley D. Ference III
Registration No. 33,879

Customer No. 35195
FERENCE & ASSOCIATES LLC
409 Broad Street
Pittsburgh, Pennsylvania 15143
(412) 741-8400
(412) 741-9292 - Facsimile

Attorneys for Applicants